Spatial and Temporal Variability in Sediment P Distribution and Speciation in Coastal LA: Implications for Hypoxia

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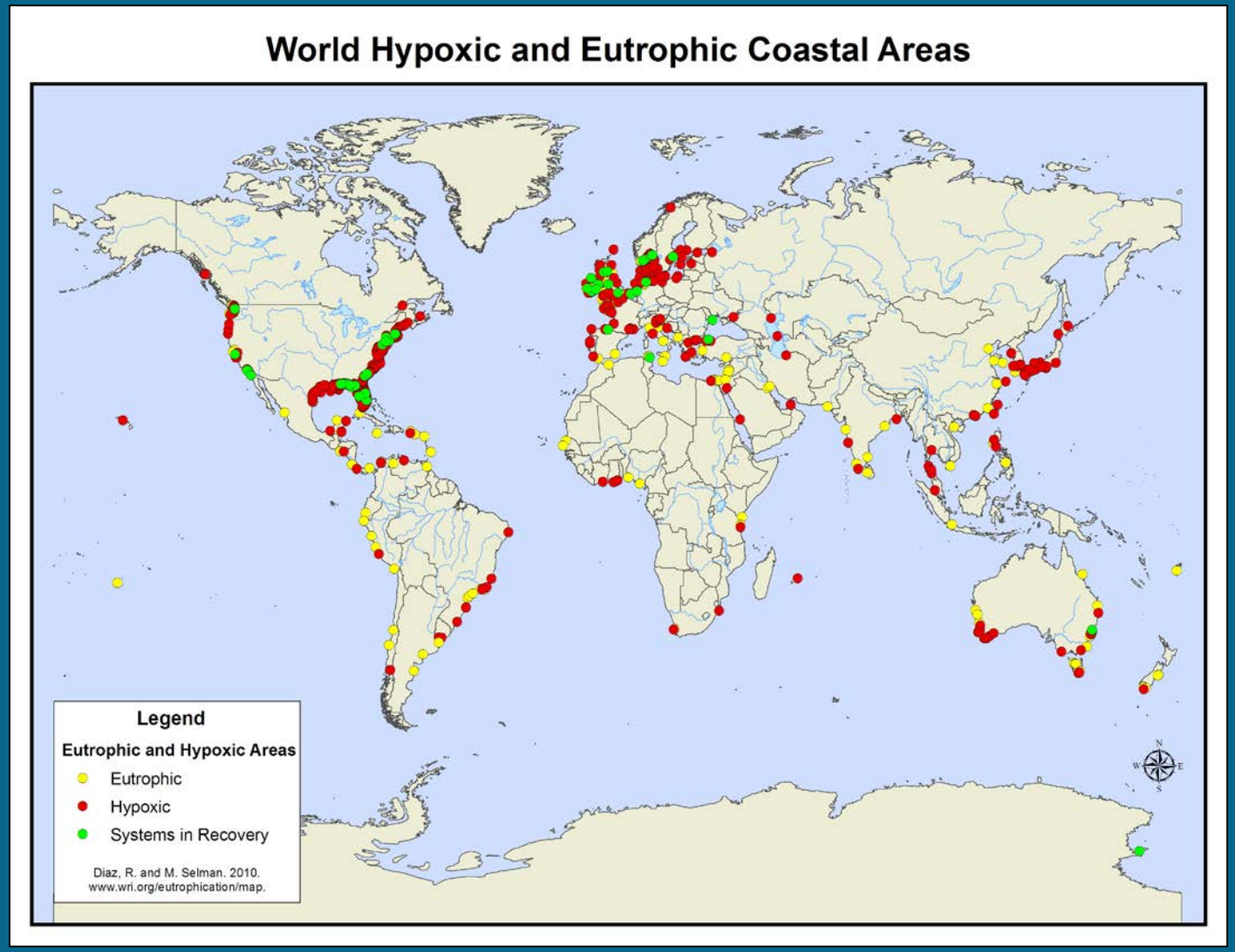
Hypoxia: A Global Issue

- *Hypoxic*: Areas (in the Gulf of Mexico) where bottom water oxygen concentrations are < 2 ppm

- *Eutrophic*: nutrient richness that causes dense plant growth, the decomposition of which kills animal life by depriving it of oxygen



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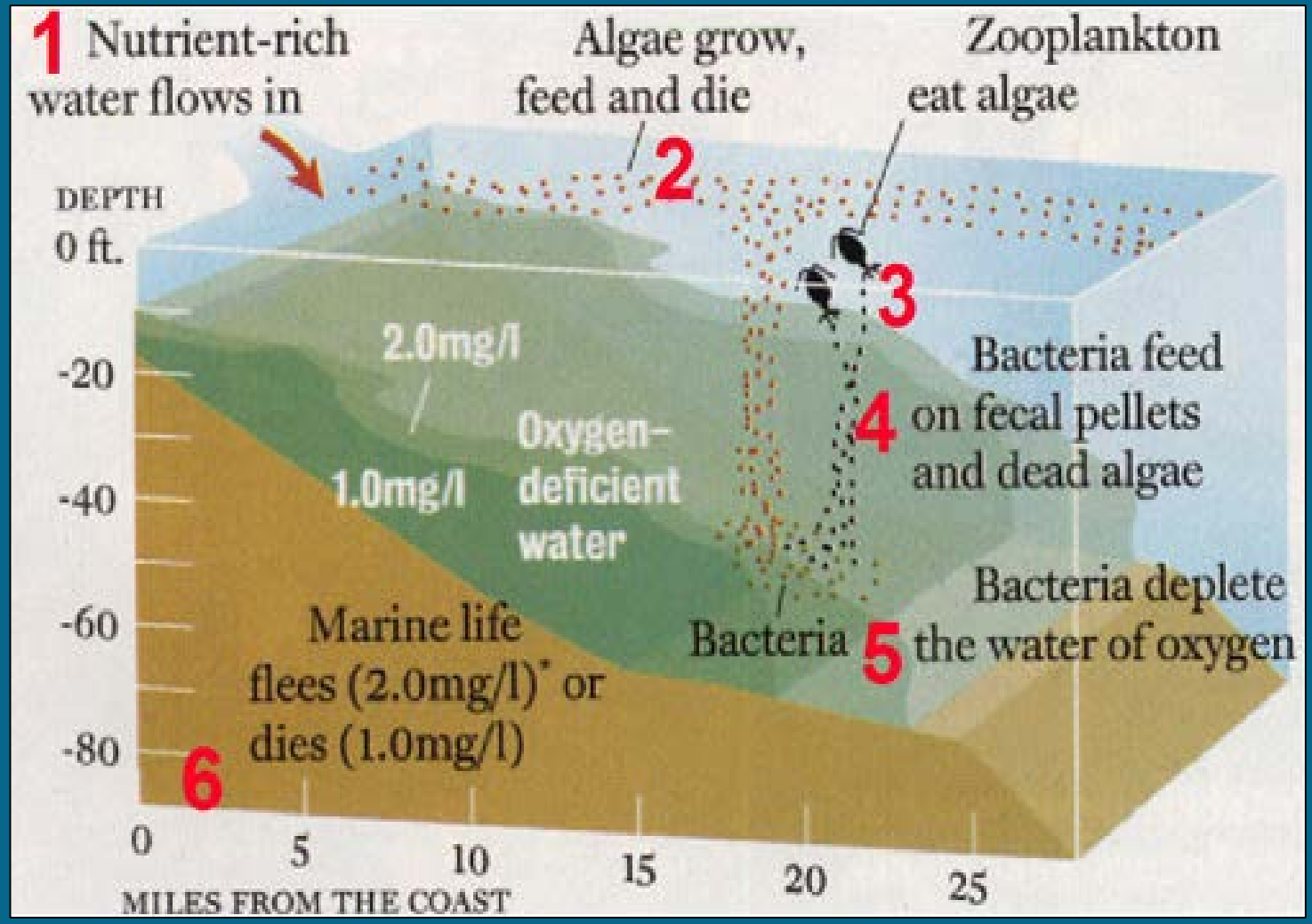


Nutrient-based Hypoxia Formation. Nancy Rabalais, Gulfhypoxia.net.

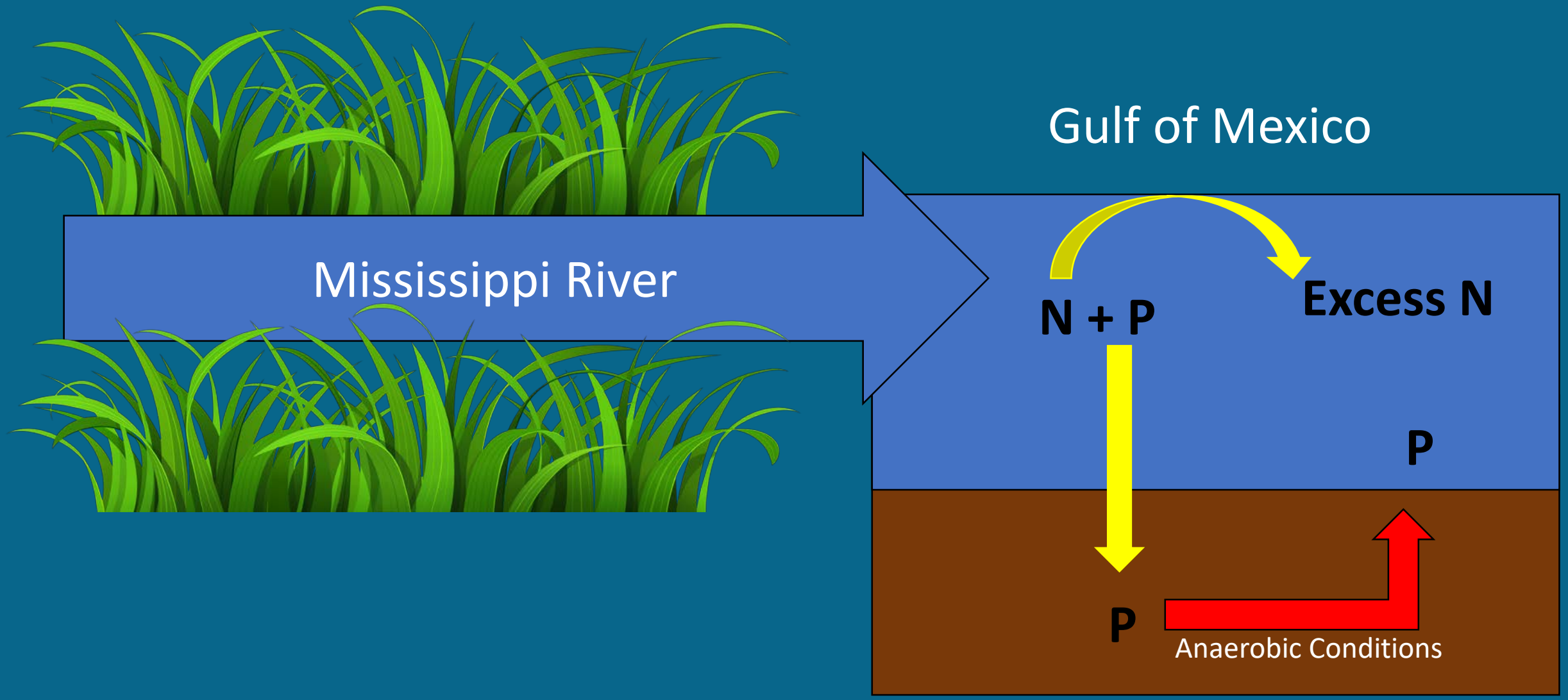
Northern Gulf of Mexico Hypoxia

Nitrogen: Phosphorus Input

- **24:1** for May 2016
- **15:1** for August 2016

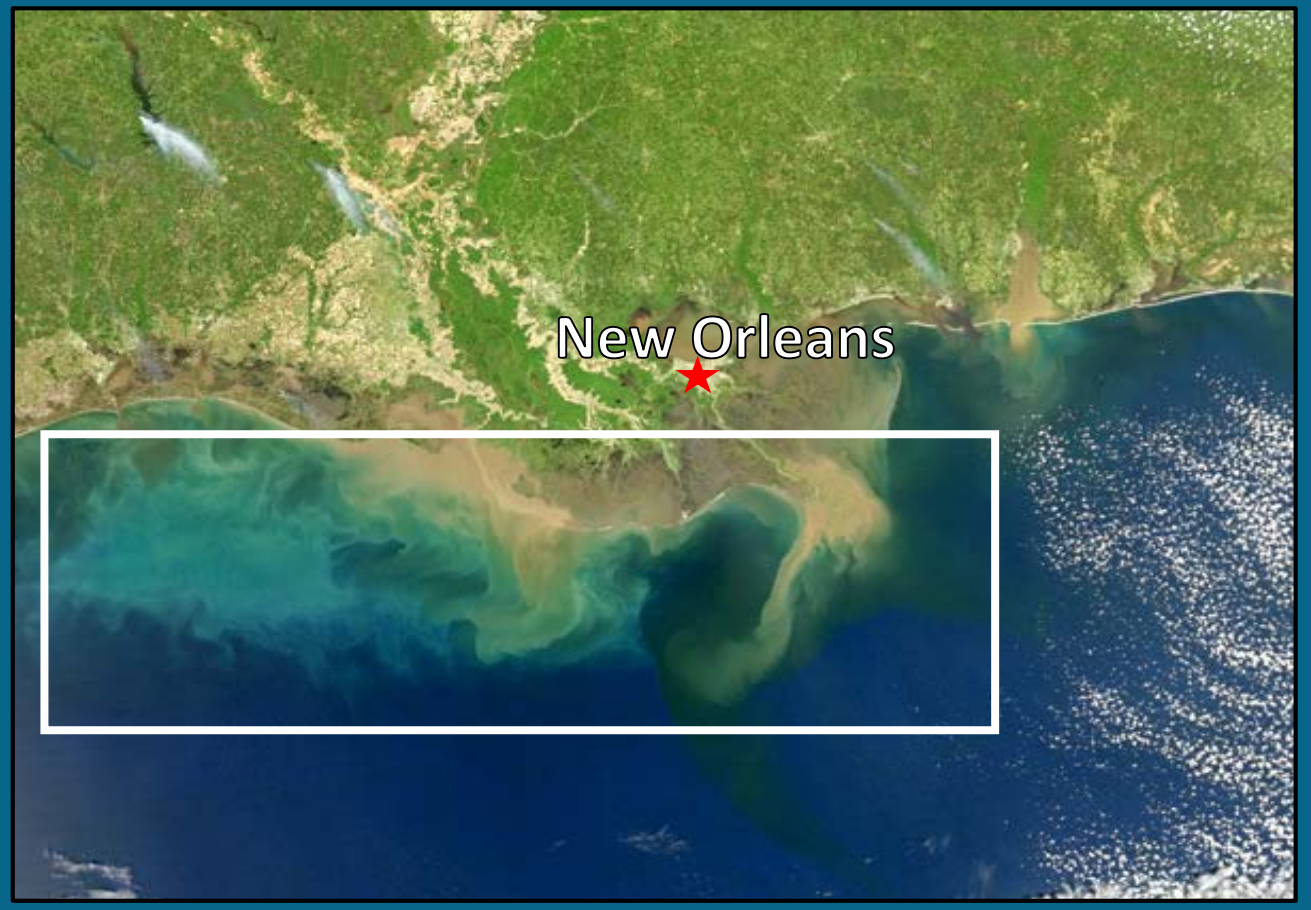
Discharge data sourced from toxics.usgs.gov.

The Mississippi River Drainage Basin. Gulfhypoxia.net


Gulf of Mexico
Mississippi River
N + P
Excess N
P
P
Anaerobic Conditions

The Gulf “Dead Zone”

- “Dead Zone” refers to fisheries
- Timing
  - Early as February
  - Late as December
  - Peak between June and July



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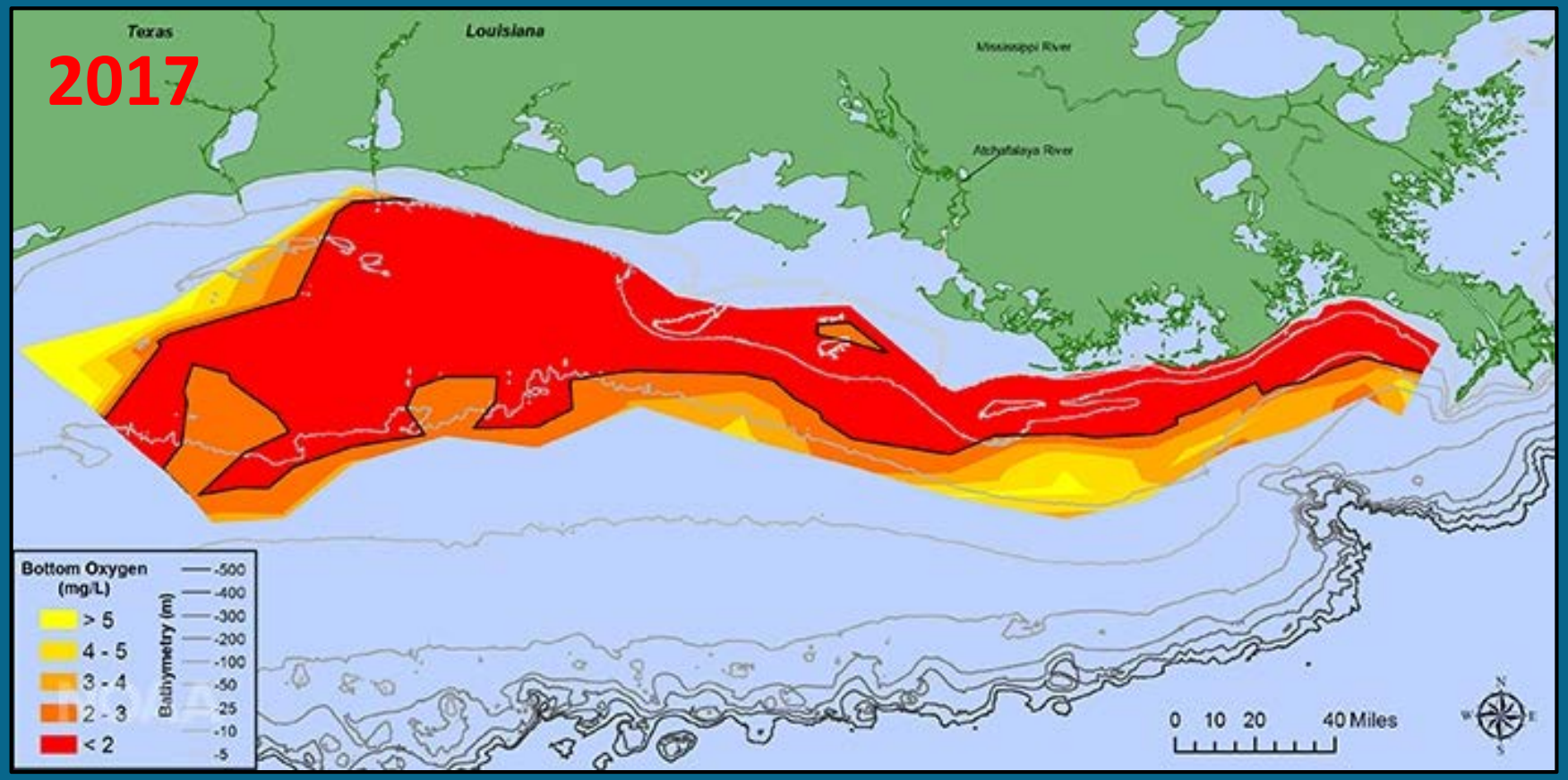
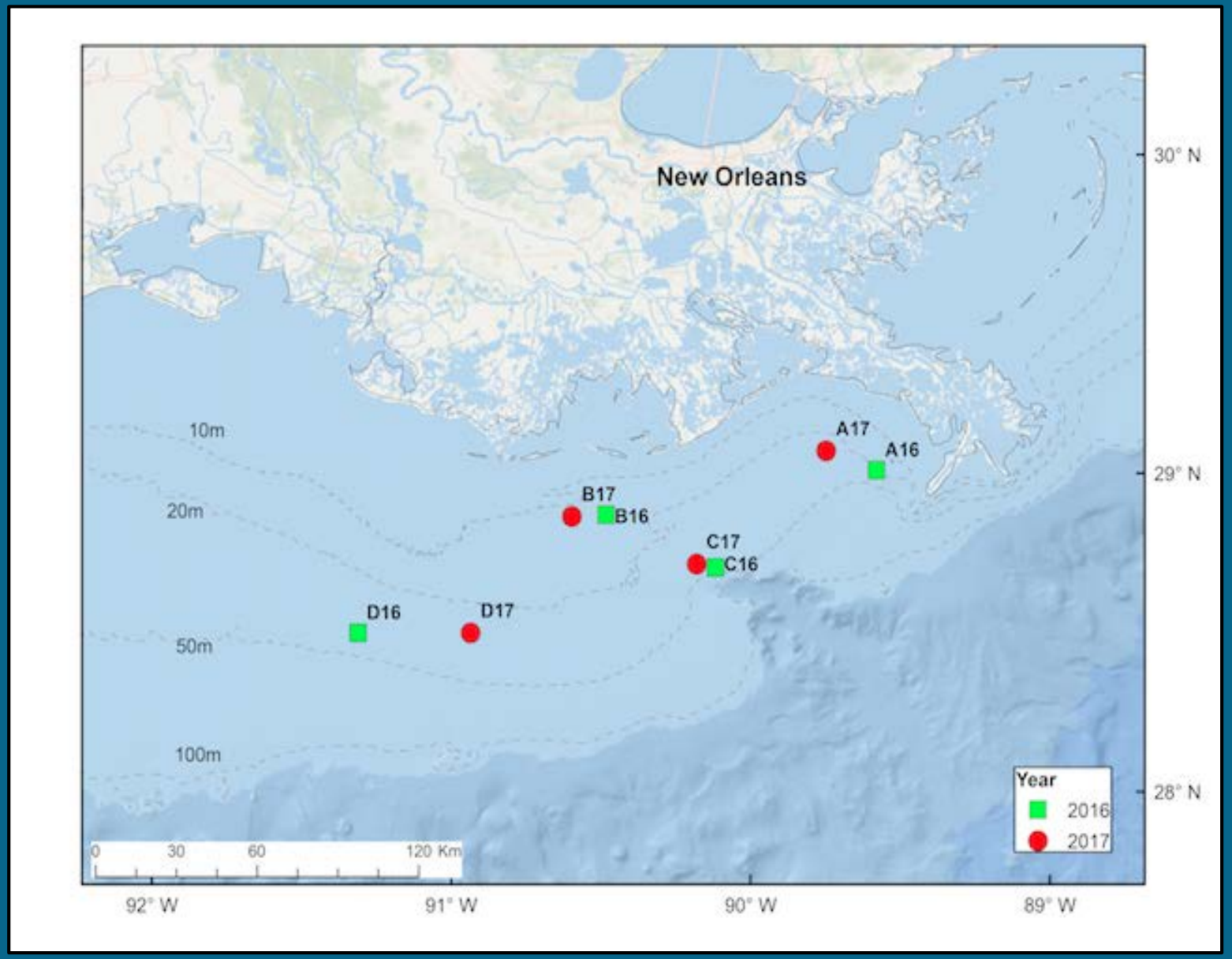


2017 Gulf Hypoxia Range Map. NOAA National Centers for Coastal Ocean Science.

Study Design

- Spatial and Temporal Variability in Sediment P Distribution and Speciation in Coastal LA: Implications for Hypoxia



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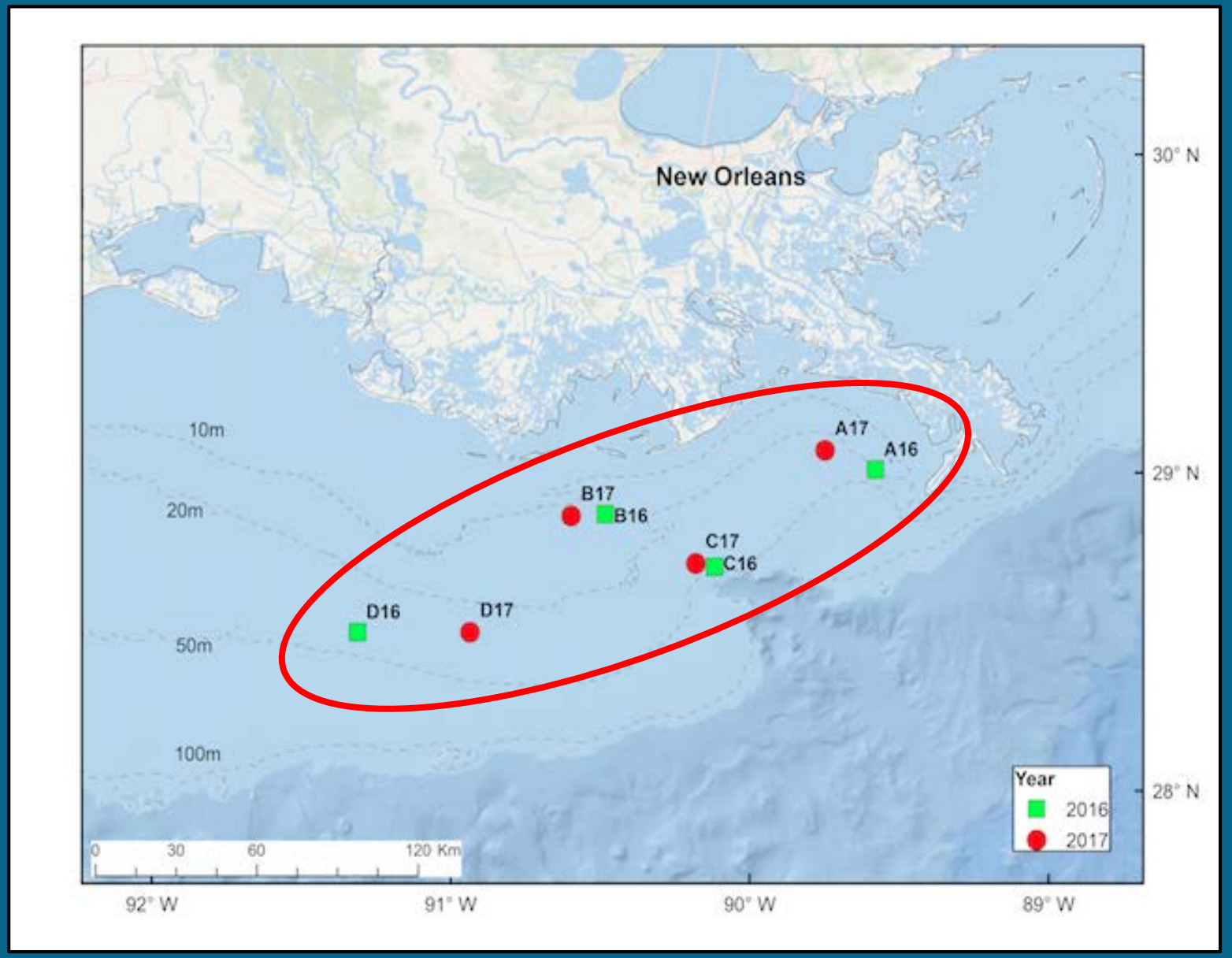

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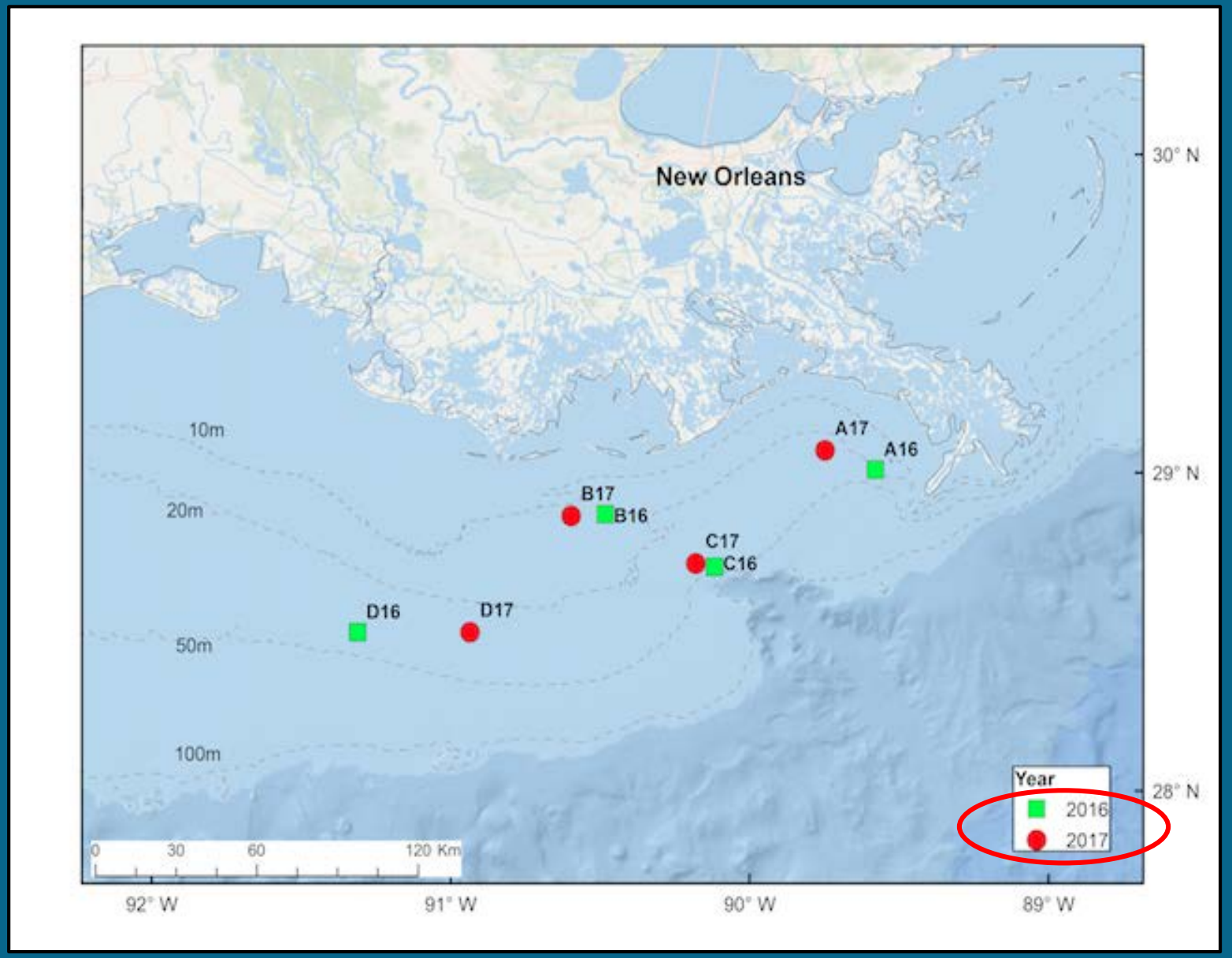

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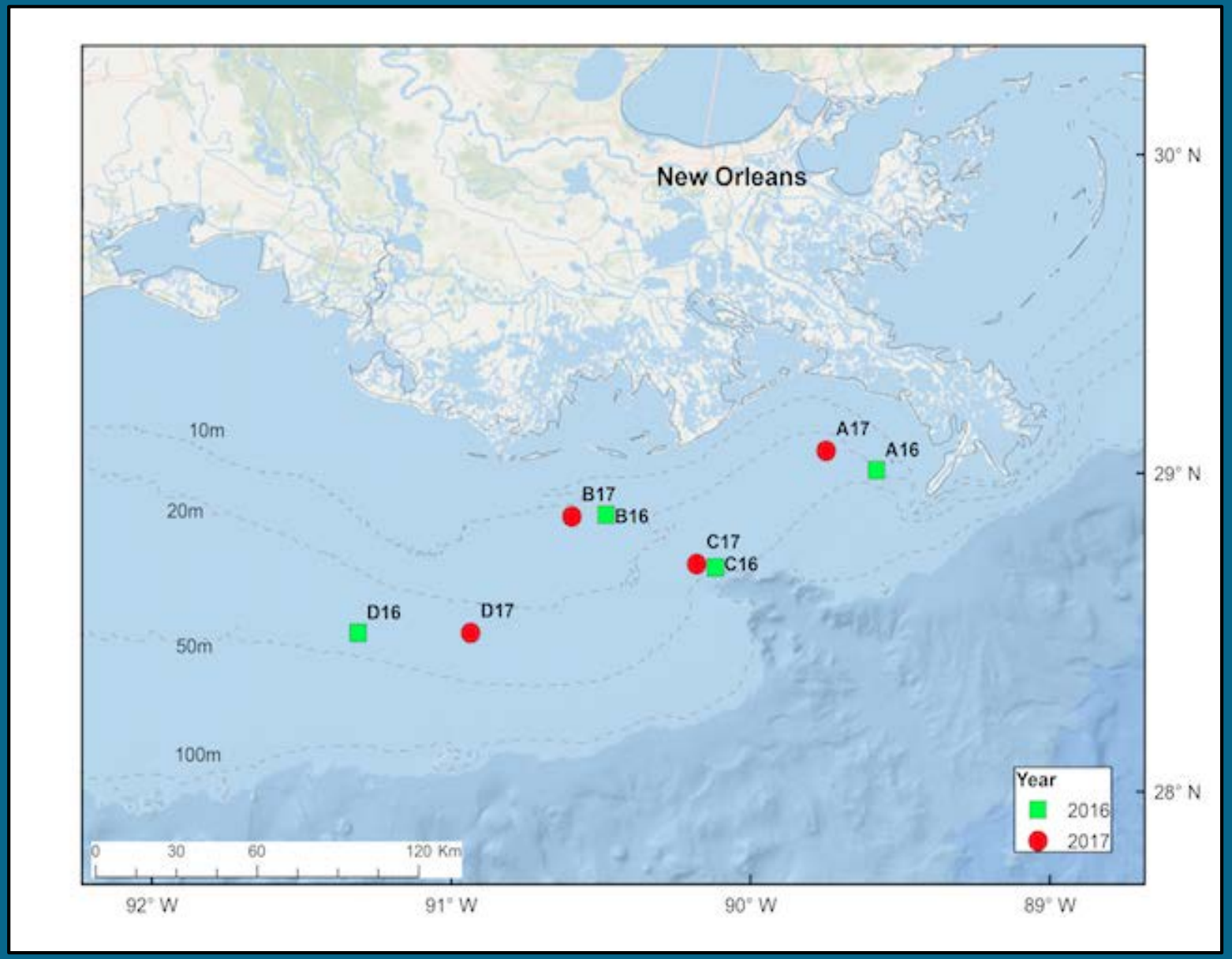

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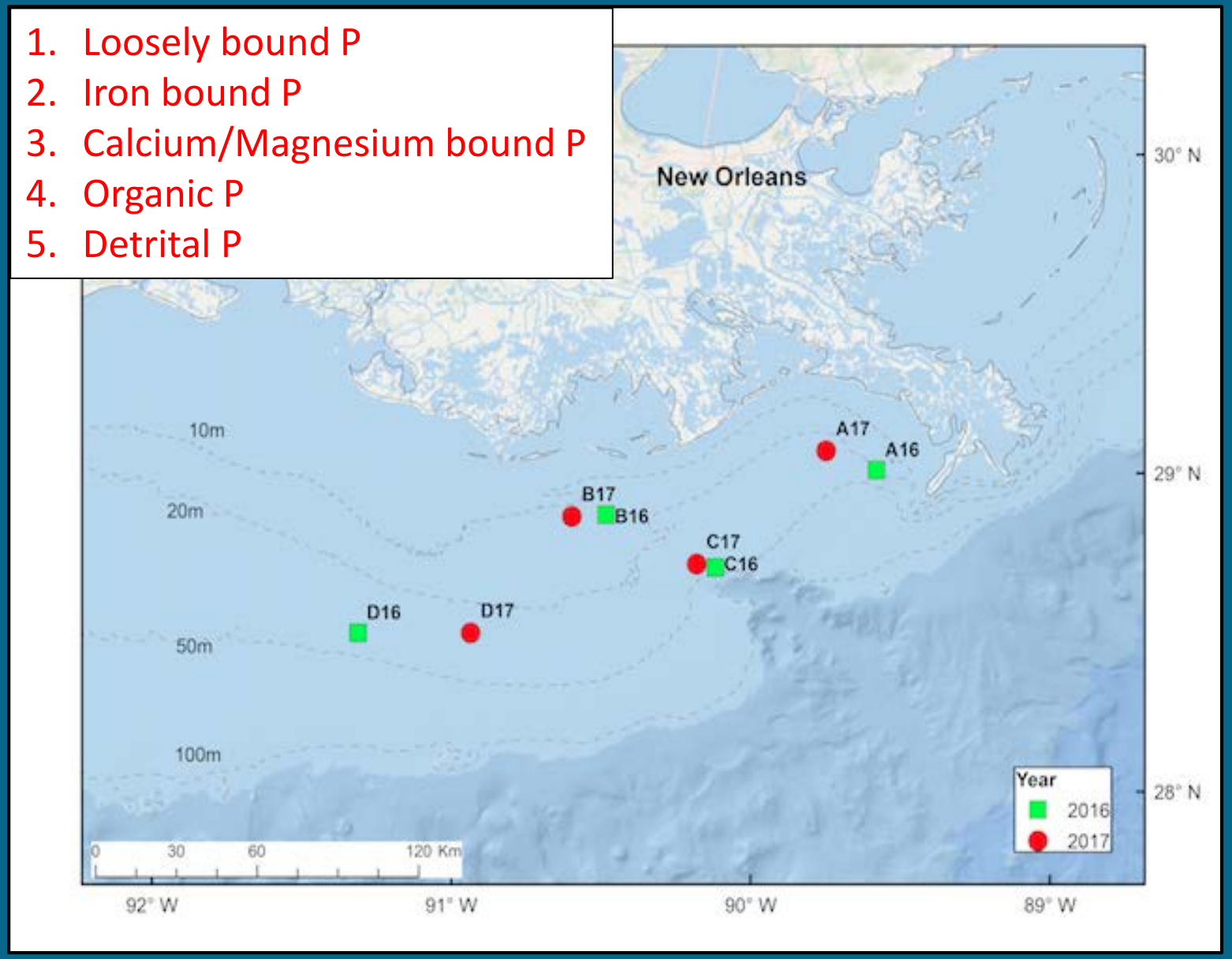
- Spatial and Temporal Variability in Sediment P Distribution and Speciation in Coastal LA: Implications for Hypoxia

1. Loosely bound P
2. Iron bound P
3. Calcium/Magnesium bound P
4. Organic P
5. Detrital P



Methods: Phosphorus Fractionation

- Sediments collected from *R/V Pelican* during August 2016 and May 2017
  - 1 cm interval slices
- *SEDEX* methodology (Ruttenberg, 1992, 2009)
- All P concentrations measured with SEAL Analytical Discrete Analyzer
- Statistics: two-tailed t-test

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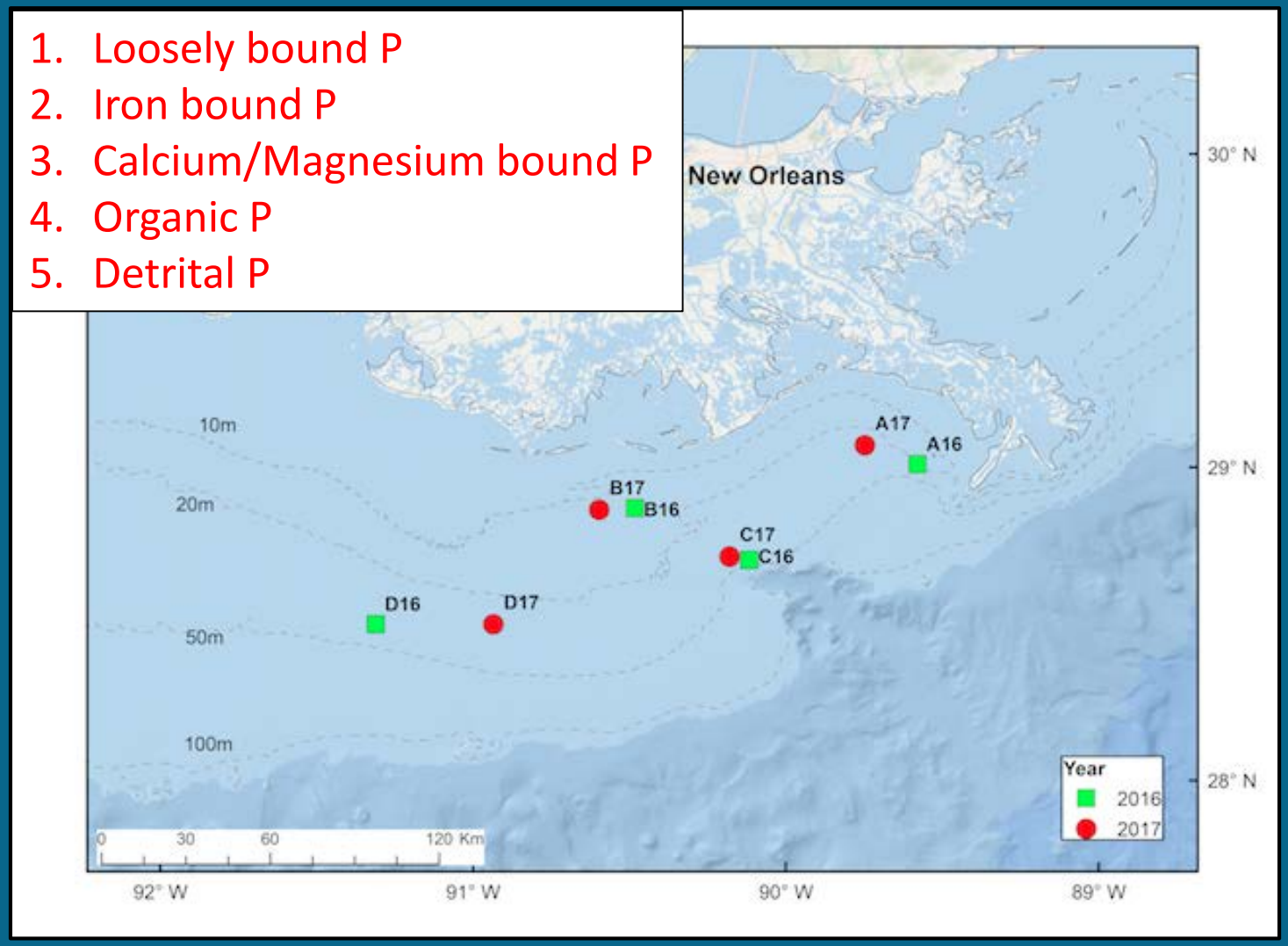


Methods: Laboratory Incubation

- Ex-situ aerobic, anaerobic, and intermediate incubation
- Triplicate cores
- Anaerobic conditions force Fe^{3+} to Fe^{2+}

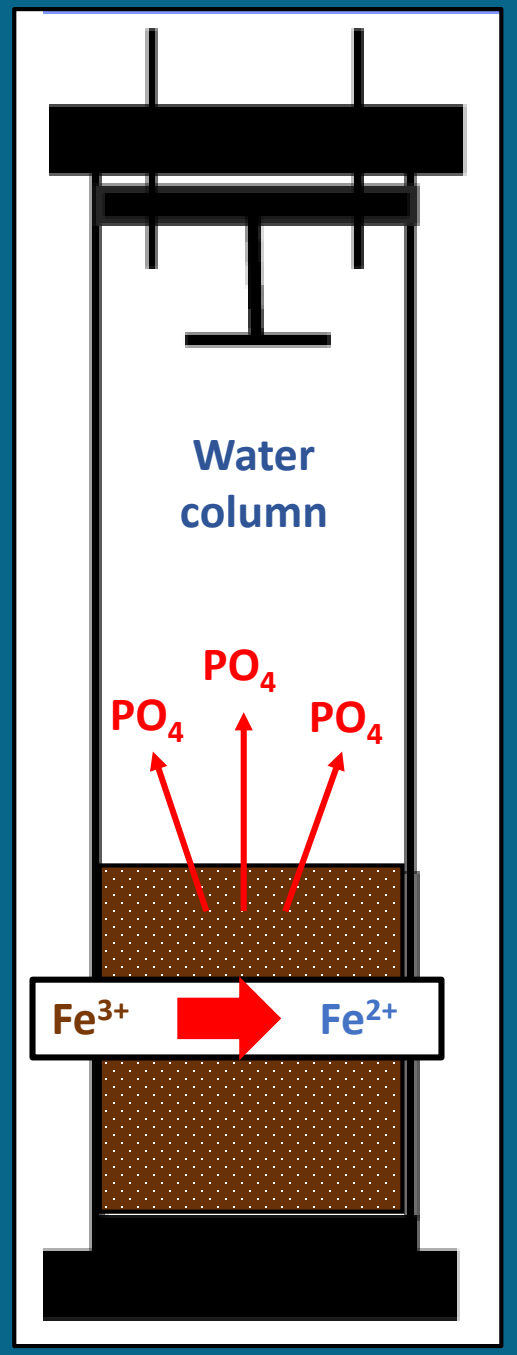
$Fe^{2+}(PO_4)$ = solubilizes

P releases into water column

Anaerobic Conditions

$Fe^{3+}(PO_4)$ = solid compound

Buried in sediment



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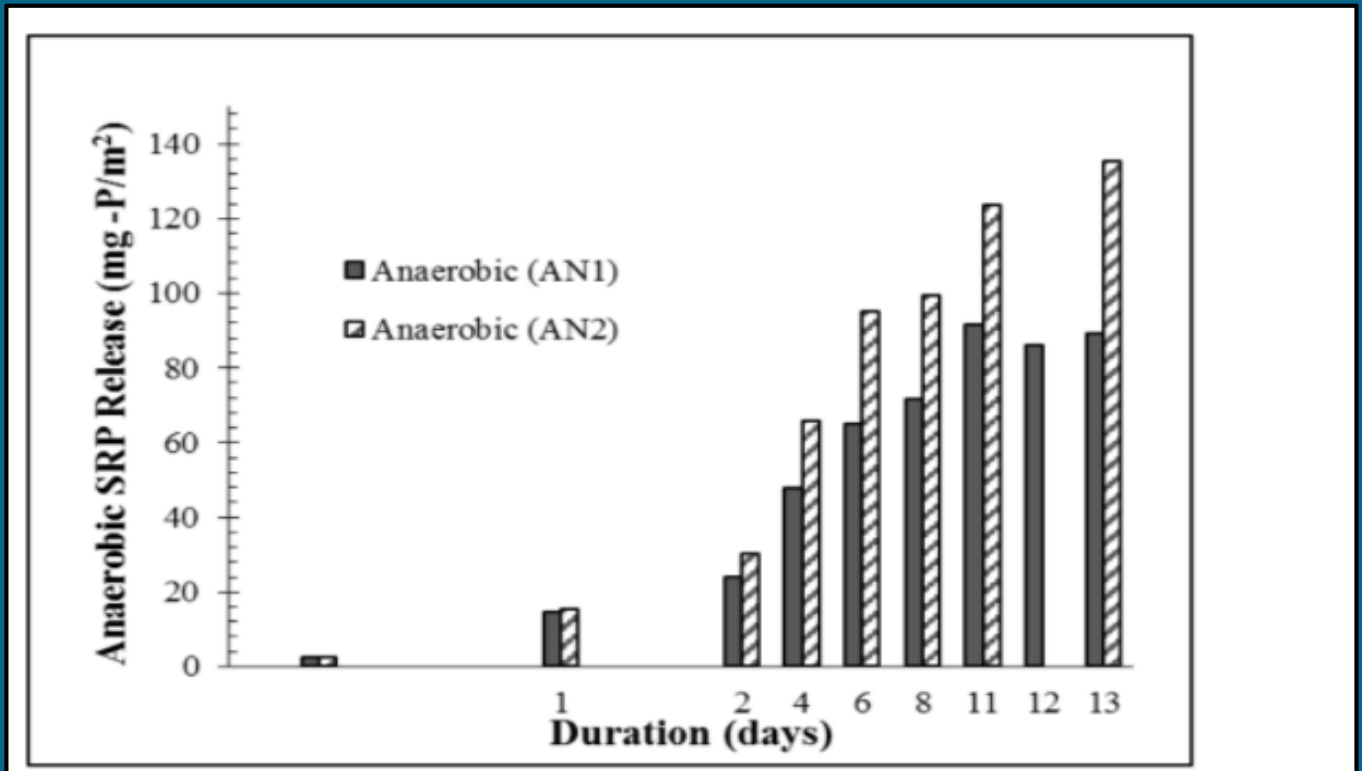
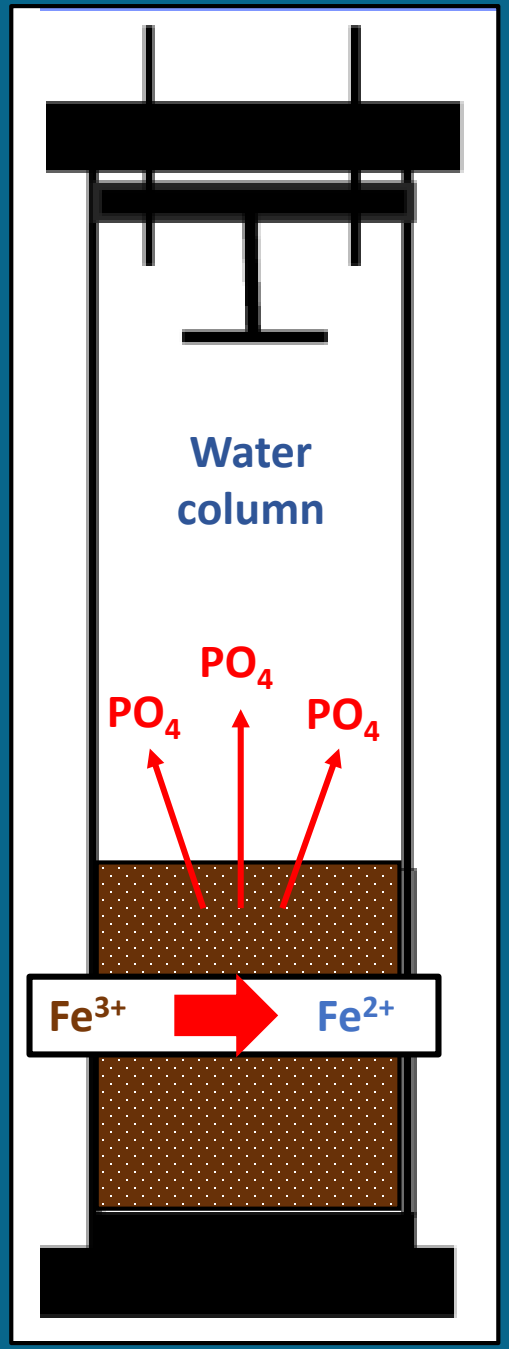


Figure 2: Water column P-release under constant anaerobic conditions



Results

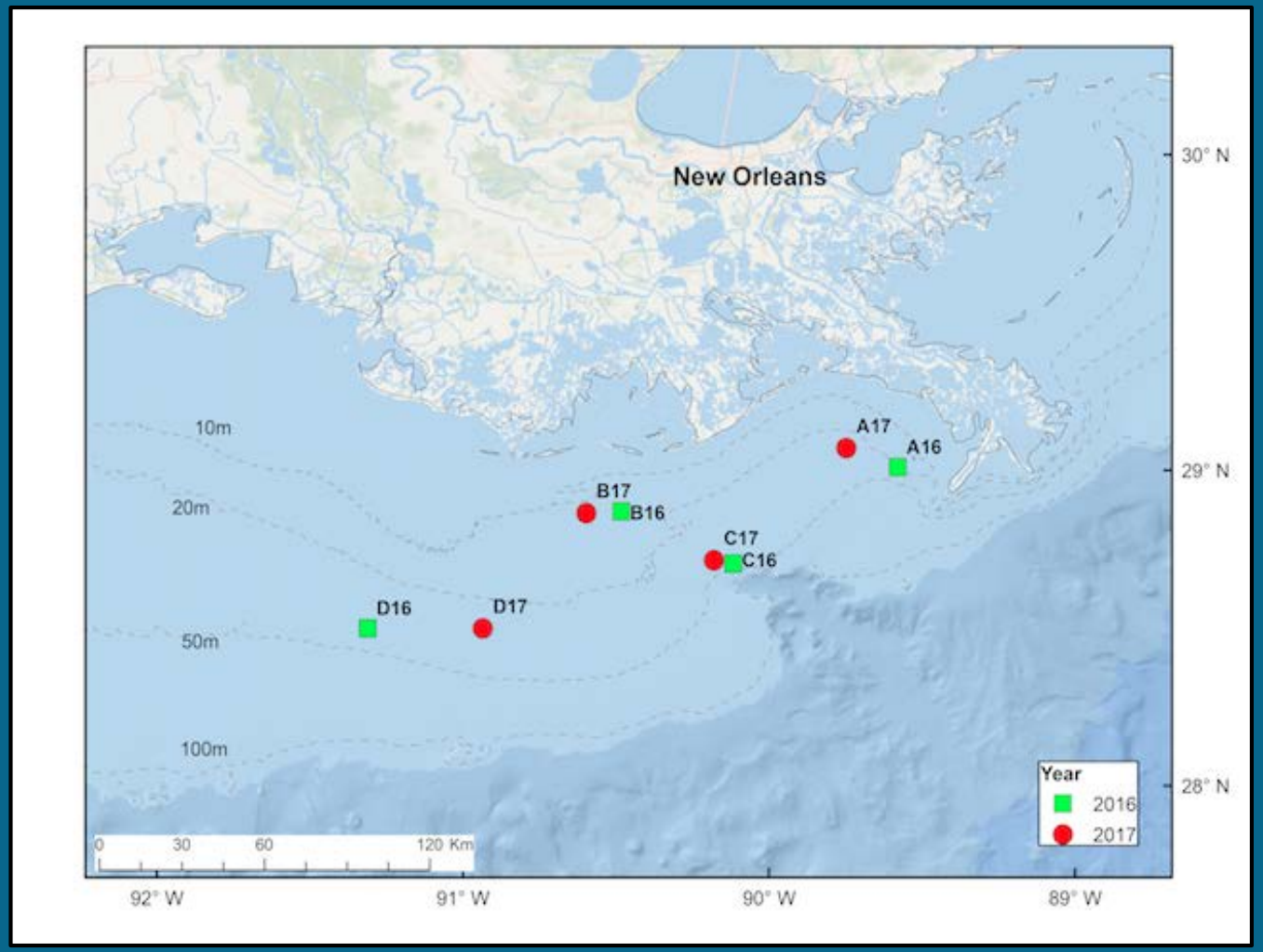
$$^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}\alpha$$

- No trend with depth or distance from MSR mouth
- ^{234}Thorium Analysis shows recent sediment deposition
- No difference in top 5 cm due to mixing
- Analyzed results as an average of the top 5 cm

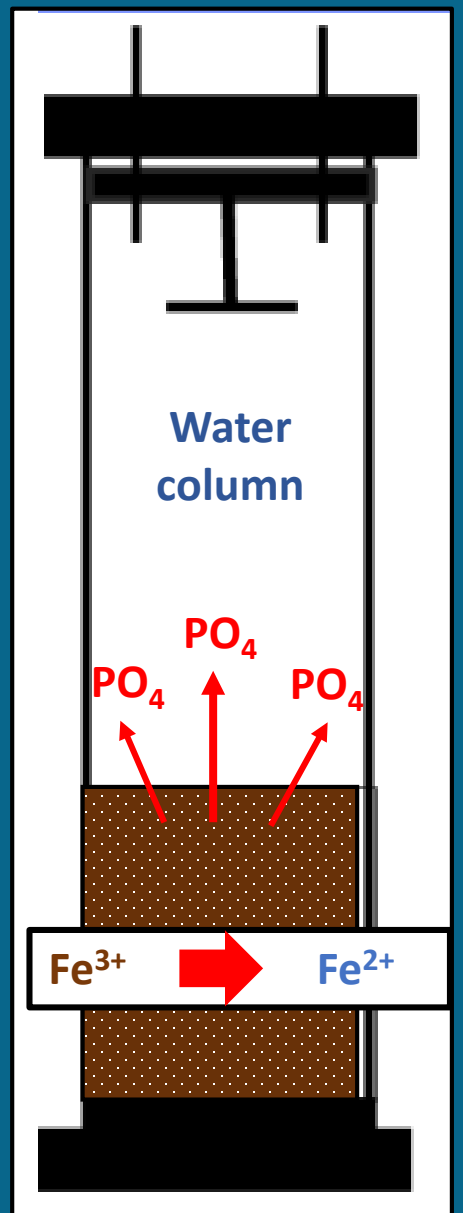
Sediment cores from R/V Pelican – May 2017

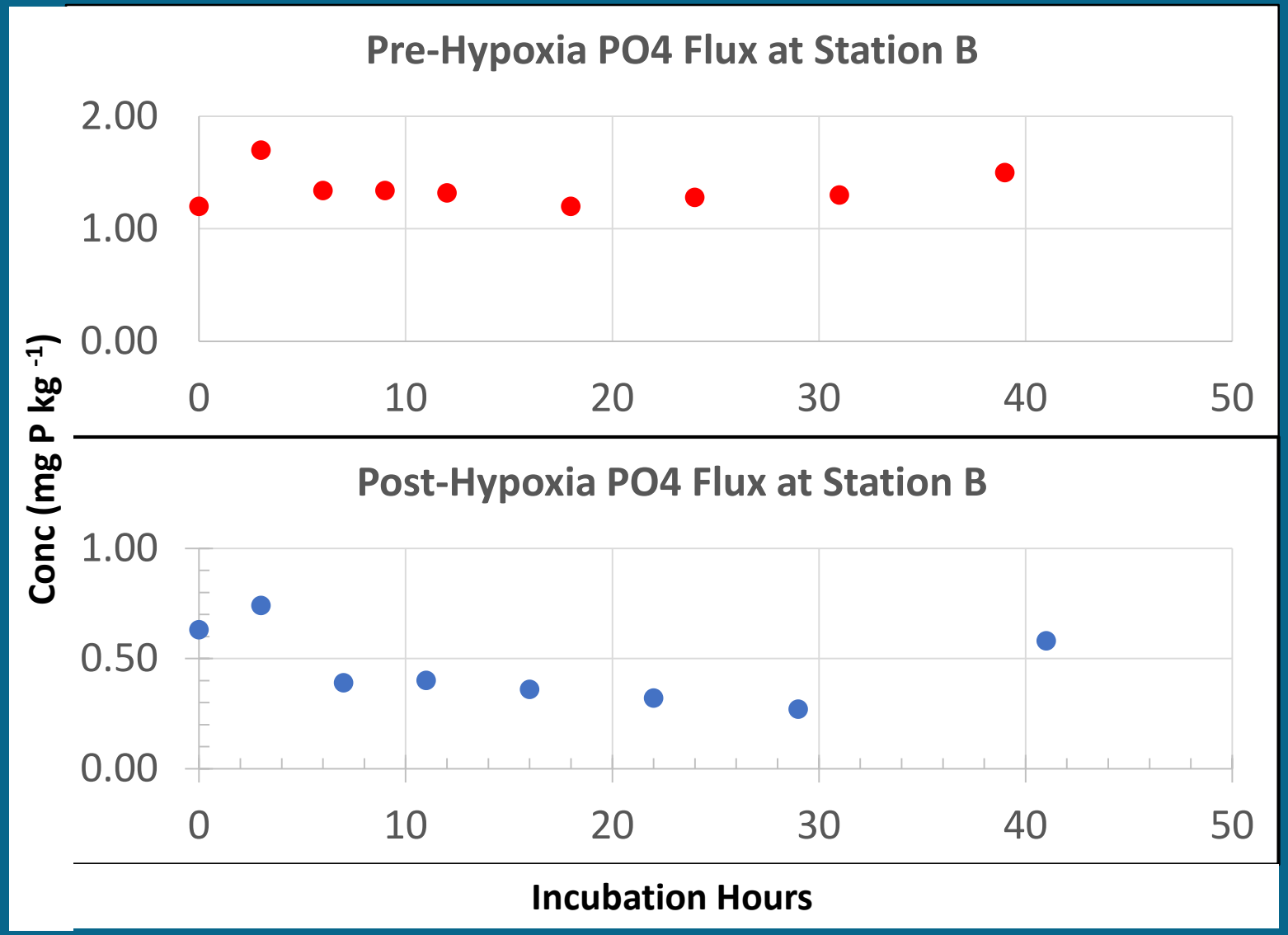
Results: Dissolved Oxygen

- Lowest at **Station B**
  - May: 1.56 mg/L O2
  - **August: 1.35 mg/L O2**
- Separate shelfwide cruise data shows Station B as completely anoxic (0 mg/L O_2) **one week prior**
- **Stations A, C, and D** are opposite
  - Dissolved O2 **lowest in May**



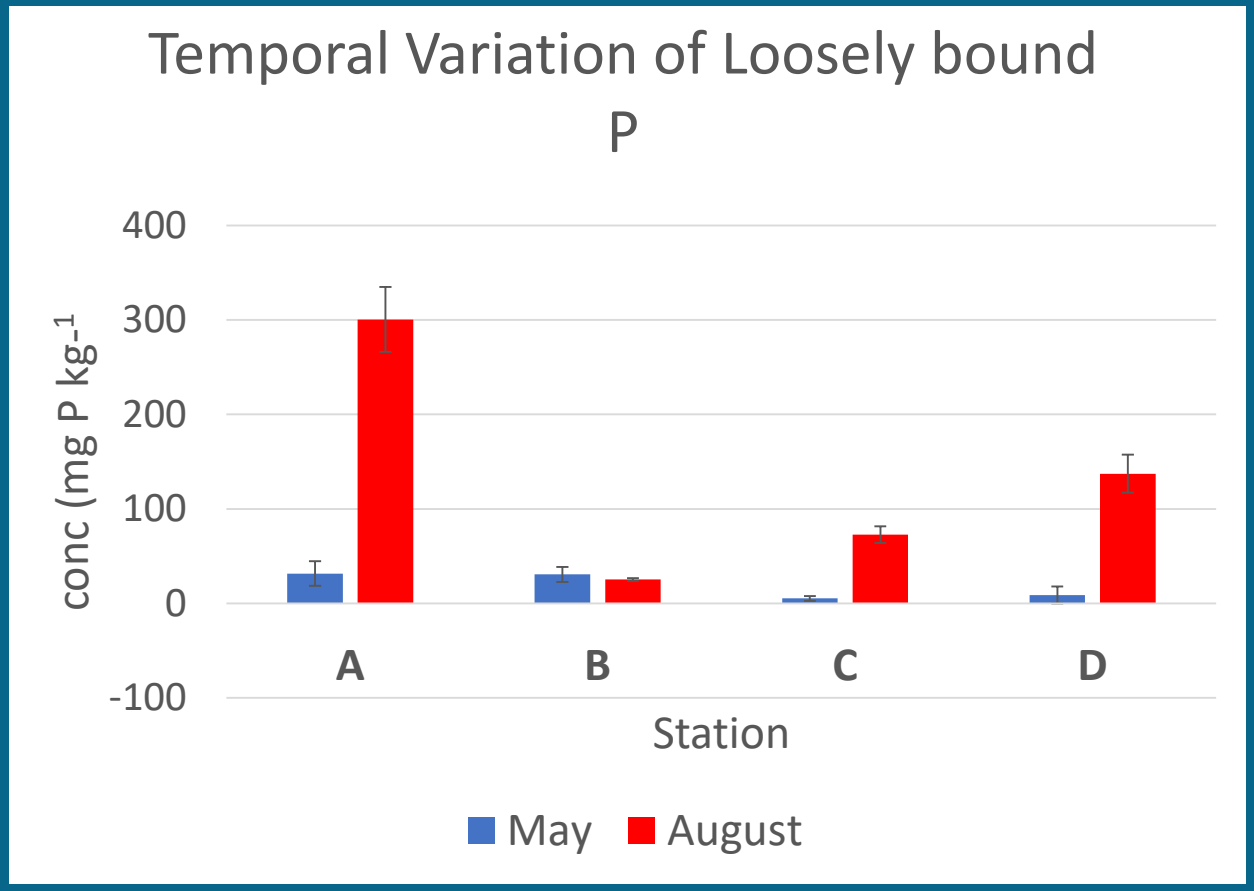
Dissolved Oxygen Concentrations and Flux Rates

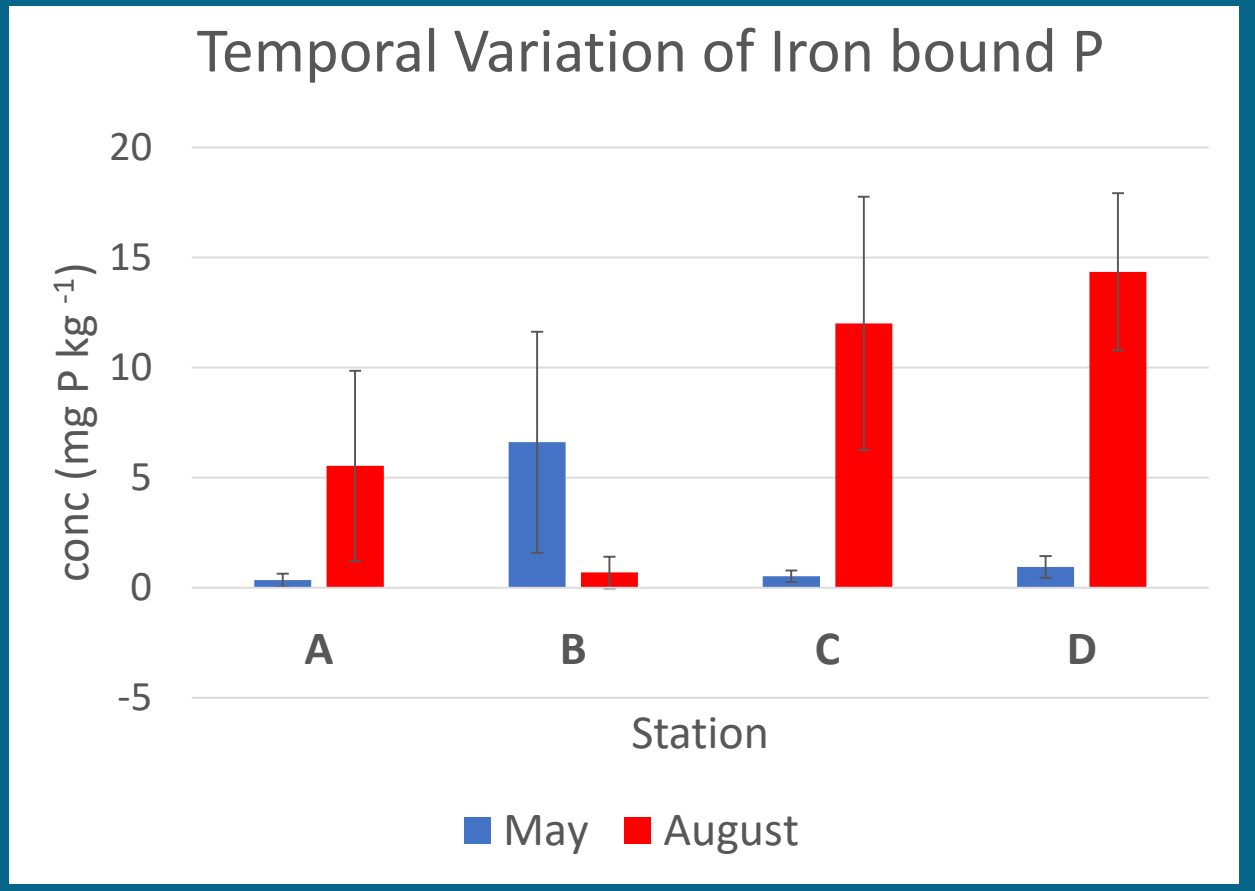




Results/Discussion

- Loosely bound P and Iron bound P **(p=0.02)** higher in post-hypoxia (August) at Stations A, C, and D





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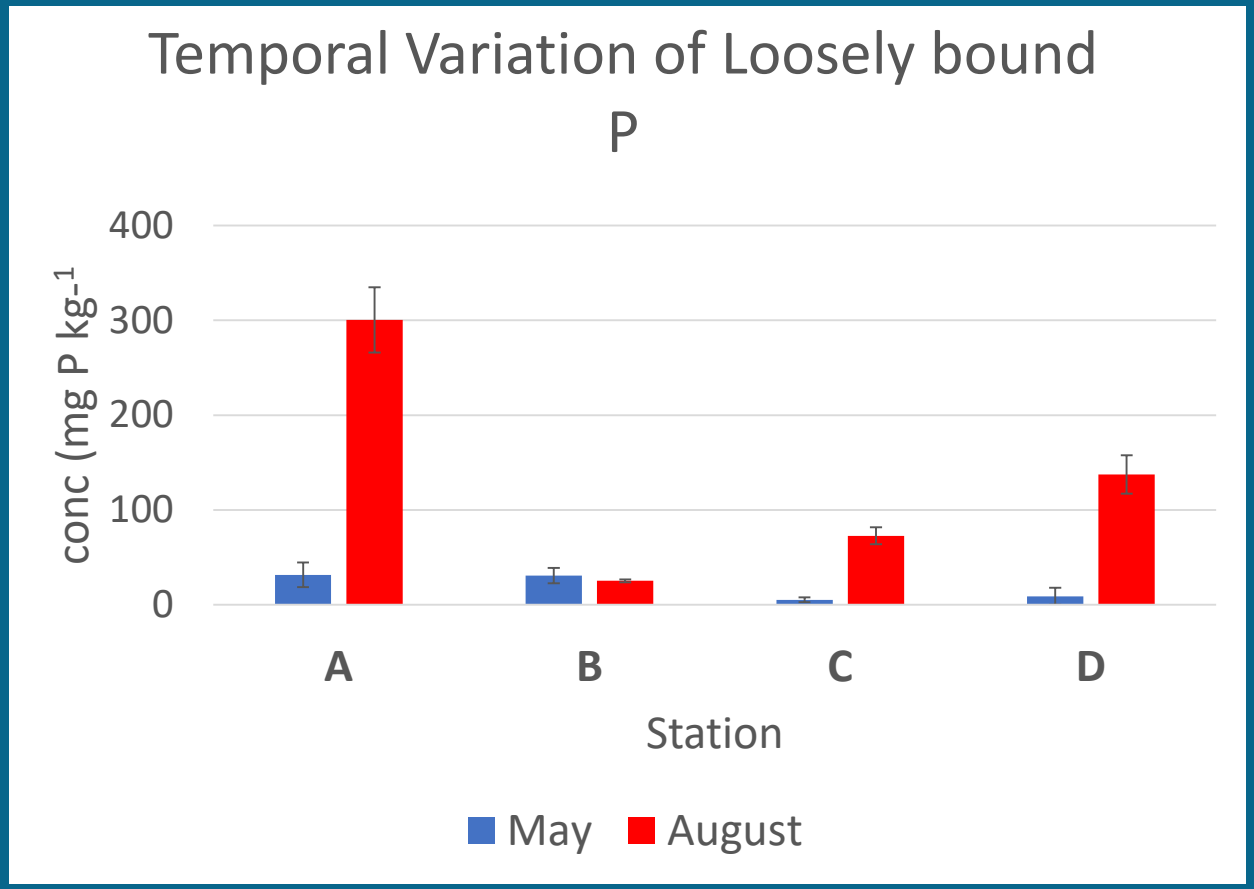
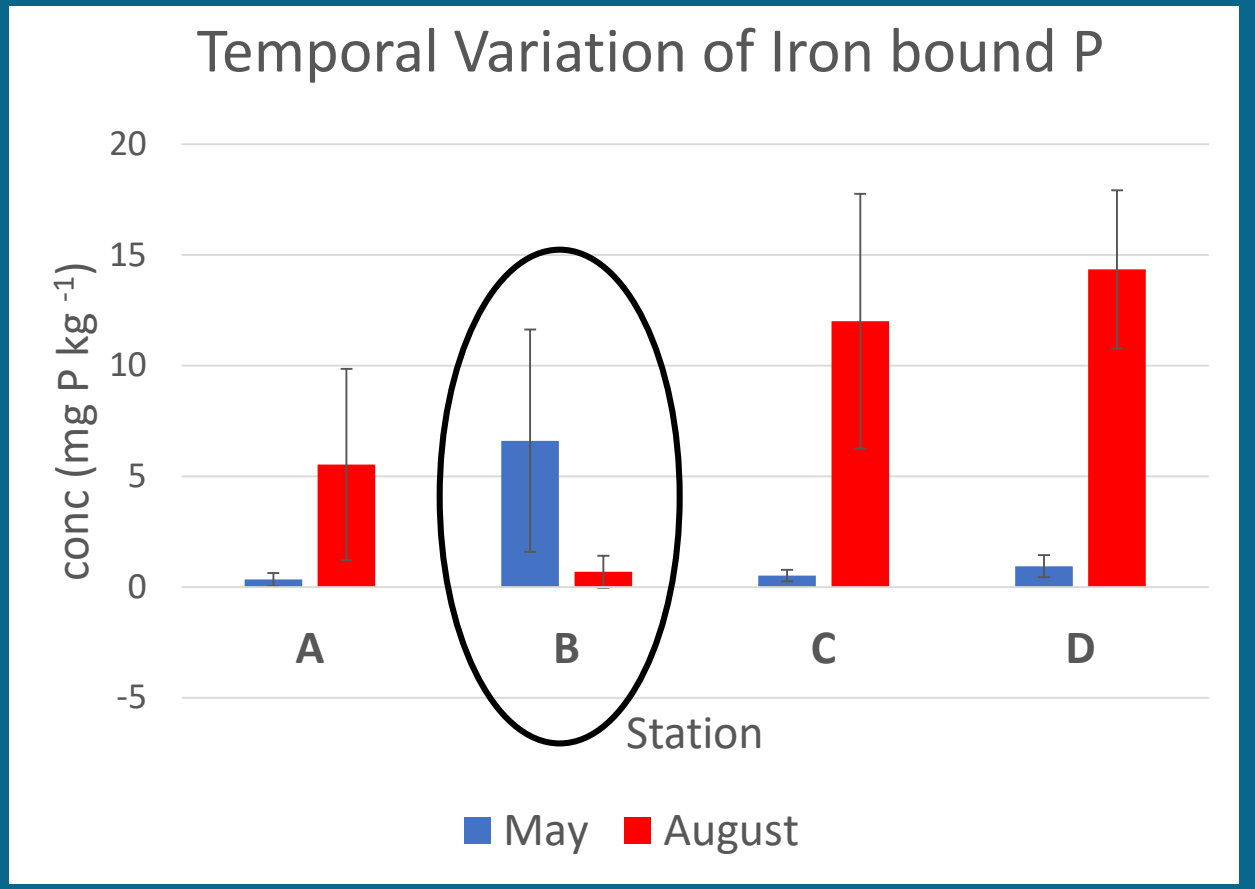
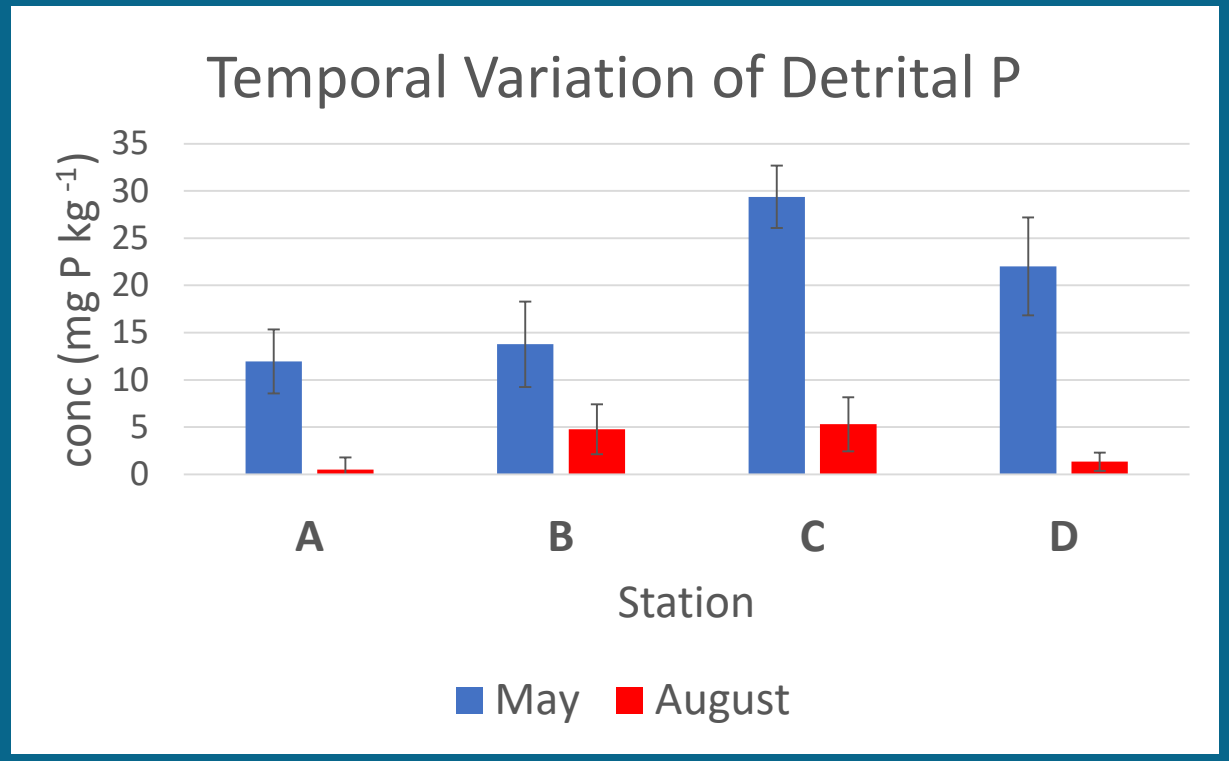
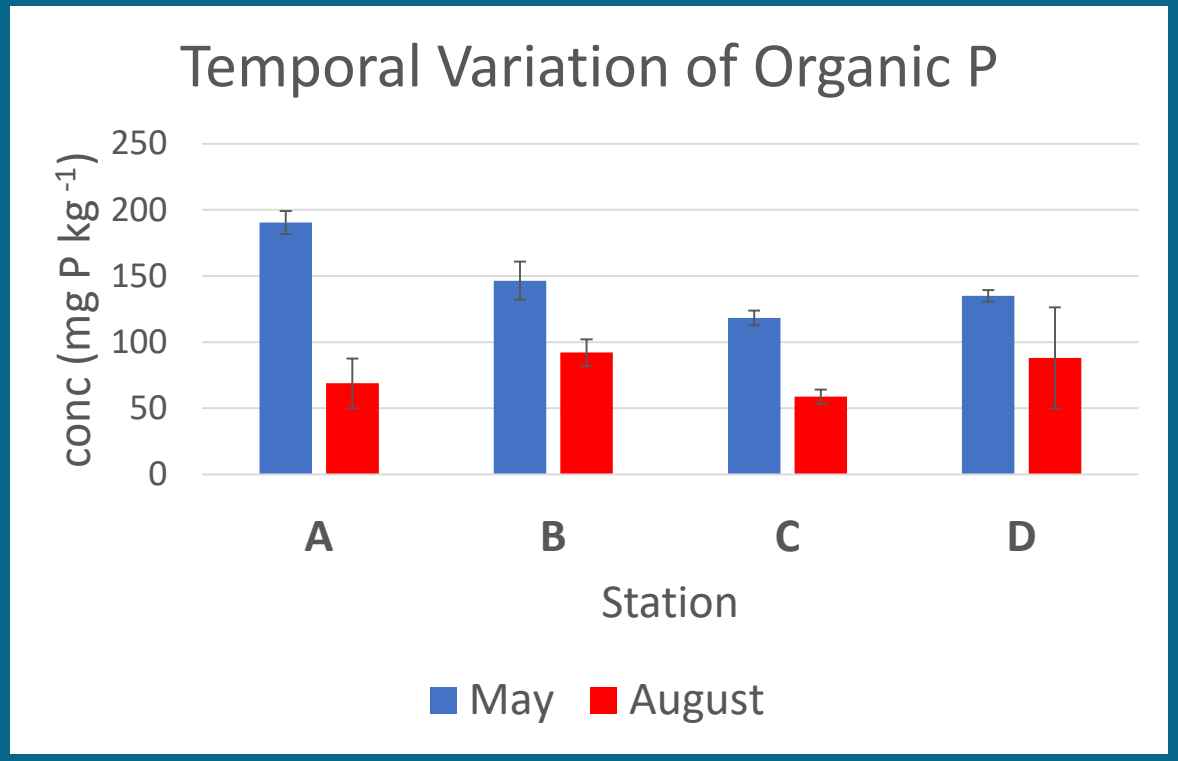




Results/Discussion

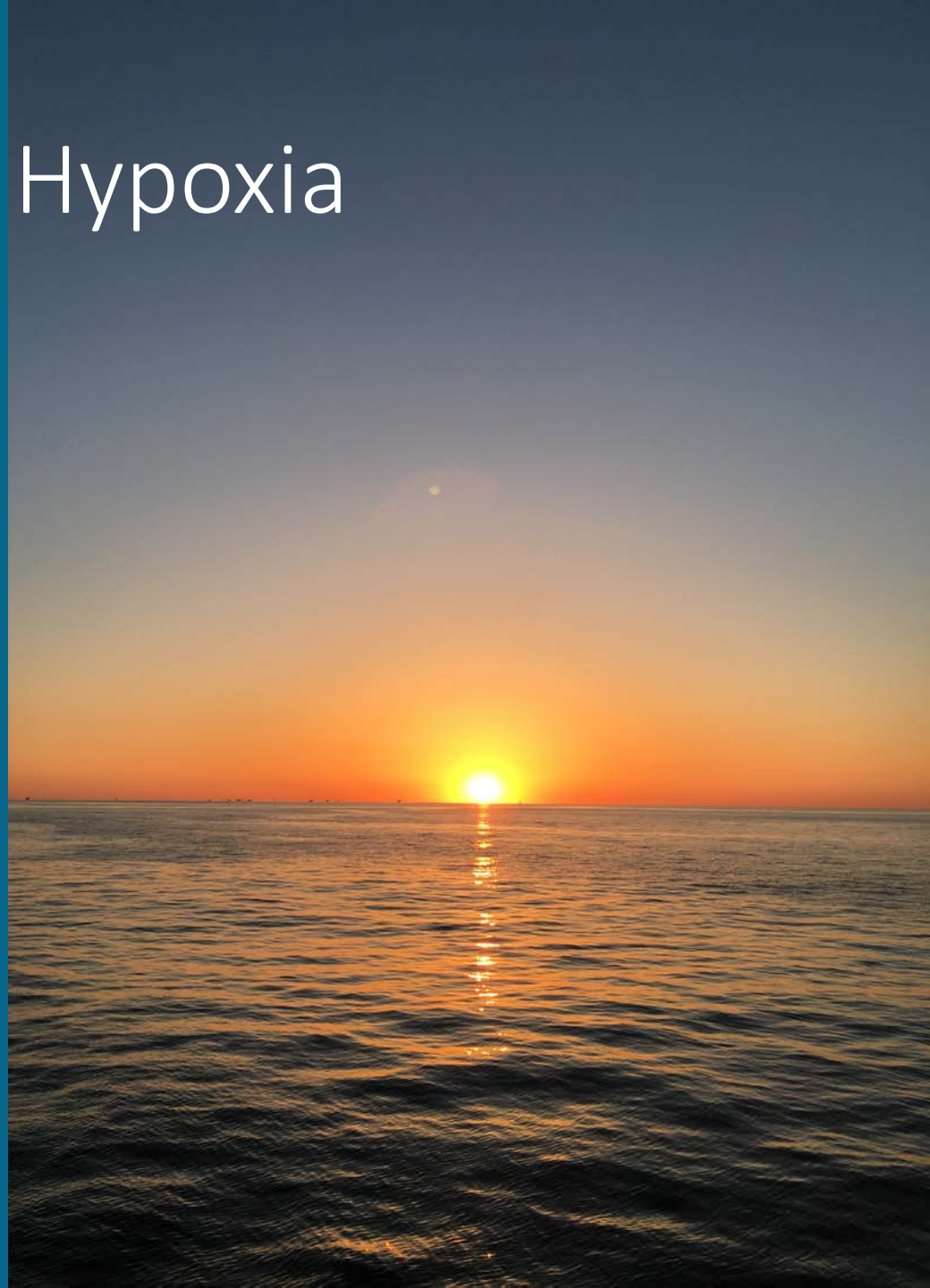
- Pre-hypoxia (May) - Organic P (+**20-30%**/ p=0.006) and Detrital P (+**5-15%**/ p=0.005)
  - Higher influx from MSR; Bloom presence in May supports more Organic P





Primary Production and Hypoxia

- Understanding primary production helps us understand hypoxia
- Marine research has its limits
- Future research



Acknowledgements

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- WABL Family
- LUMCON crew
- National Science Foundation

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